What is claimed is:

1. A method for manufacturing a semiconductor device comprising:

a step of forming a groove for forming a device isolation part extending from a main surface of a semiconductor substrate to an intermediate depth of the semiconductor substrate;

a step of forming by wet oxidation a first thermal oxide film extending from over a bottom surface of the groove to an intermediate point on a sidewall of the groove; and

a step of forming by dry oxidation a second thermal oxide film extending from the intermediate point on the sidewall of the groove to over the main surface of the semiconductor substrate.

2. A method for manufacturing a semiconductor device according to claim 1, wherein the groove forming step is to form, by patterning, a mask exposing a region of the main surface corresponding to the groove to be formed in the main surface, and thereafter first etching is carried out using the mask on the semiconductor substrate thereby forming the groove on the main surface of the semiconductor substrate;

the first thermal oxide film forming step including a step of forming by wet oxidation a pre-first thermal

oxide film extending from over a bottom surface of the groove to over a region of the main surface of the semiconductor substrate outside the groove, a step of forming an etching-resisting film covering the pre-first thermal oxide film at a bottom surface part of the groove, and a step of carrying out second etching on the pre-first thermal oxide film by using the etching-resisting film and selectively removing the pre-first thermal oxide film in a part extending from the main surface of the semiconductor substrate to the intermediate point, to make a part of the pre-first thermal oxide film remained by removal into the first thermal oxide film; and

the second thermal oxide film forming step including a step of forming the second thermal oxide film extending from the intermediate point on the sidewall of the groove to over a main surface part of the semiconductor substrate outside the groove while remaining the etching-resisting film as an antioxidation film.

3. A method for manufacturing a semiconductor device according to claim 2, wherein the etching-resisting film is formed extending from over a bottom surface of the groove to over a region of the main surface outside the groove and, prior to the second etching, the etching-resisting film is polished in a manner exposing a surface of the pre-first thermal oxide film on the main surface.

4. A method for manufacturing a semiconductor device according to claim 1, further including a step of forming a protection film on the second thermal oxide film on the main surface of the semiconductor substrate outside the groove, a step of depositing an insulation film in a manner filling the groove and covering the protection film, a step of polishing the insulation film in a manner exposing a surface of the protection film, and a step of removing the protection film and making a part of the insulation film remained in the groove into a device isolation part.

5. A method for manufacturing a semiconductor device according to claim 1, wherein a heating temperature Tw (°C) of the semiconductor substrate in the wet oxidation is in a range of from 700 to 1000 °C, a heating temperature Td (°C) of the semiconductor substrate in the dry oxidation is in a range of from 800 to 1200 °C, and the wet oxidation and dry oxidation is carried out under a condition satisfying Tw (°C) ≤ Td (°C).

6. A method for manufacturing a semiconductor device according to claim 2, wherein the second etching is carried out by using an etching solution containing hydrogen fluoride acid.